REMARKS/ARGUMENTS

As discussed with Examiner Stelling on October 15, 2008, Applicant has filed an RCE in order to ensure the entry of the above amendment. As further agreed, Examiner Stelling will contact Applicant's undersigned attorney to arrange an interview prior to an action on the merits. Examiner Stelling is thanked for this consideration.

New Claims 10-25 are based on previously pending Claims 1-9. Descriptive support for the phrase "such that organisms viable in the ship ballast water are exterminated and the concentration of dissolved oxygen in the ship ballast water is maintained at a level viable to said organisms" can be found at, e.g., page 4, lines 13-23, the paragraph bridging specification pages 5-6, and in the Examples starting at specification page 11. No new matter has been added.

The present inventors are the first to simply and effectively solve the problem of exterminating organisms in the ballast water of a ship while maintaining an oxygen level therein sufficient to sustain such organisms. While these twin goals initially seem contradictory, they make sense when one realizes how ship ballast water is used, its "life cycle", and under what conditions it exists.

A ship ballast is a dark, closed system, and over the course of time the concentration of dissolved oxygen in the ballast water decreases. When this water, having a depleted oxygen level, is then emptied into surrounding waters the local ecosystem can be severely damaged, creating dead zones. See Applicant's Specification, page 1, line 11, to page 3, line 3. At the same time, organisms in the ballast water have to be controlled to prevent clogging, prevent the introduction of invading species to new ports, etc. Applicant's claimed method addresses both of these concerns by not only exterminating the organisms in the ship ballast water but by also maintaining an organism-friendly concentration of dissolved oxygen in the ballast water (Spec., p. 4, ll. 12-23).

In this regard, the problems that persons having ordinary skill in the art face when emptying ballast water into the waters of an ecosystem are many and more complex than perhaps initially understood. It is not enough to deal with the above problems piecemeal. The problems facing the ecosystem and the ship ballast must be considered as a whole. In one example, in Applicant's claimed method the combination of hydrogen peroxide and ferrous ion in the ballast water provides sufficient hydrogen peroxide to exterminate the offending organisms in the ballast water and sufficient ferrous ion to break down the hydrogen peroxide at a rate such that the dissolved oxygen concentration in the ballast water is maintained at a level viable to organisms in the surrounding ecosystem. Catalase and iodine play a role similar to ferrous ion. The evidence in Applicant's Specification shows no less, and the import of the method Applicant claims to both the state of the art and state of the environment should not be considered lightly.

Applicant's previously pending Claims 1 and 3-9 were finally rejected under 35 U.S.C. §103(a) over JP 05-000910, dated January 8, 1993 (hereafter Shuzo)(which corresponds to U.S. Patent 5,256,423, dated October 26, 1993) in view of JP 2002-086155, dated March 26, 2002 (hereafter Keisuke), JP 01-094997, dated April 13, 1989 (hereafter Kozo), Ikuta, *Biofouling Control Using A Synergistic Hydrogen Peroxide and Ferrous Ion Technique*, 49th Annual Meeting, International Water Conference, 1998 (hereafter Ikuta), and Merck Index Monograph No. 01990 (Final Office Action (FOA), p. 3, para. 4).

1. Obviousness in view of the cited References

Shuzo teaches the addition of hydrogen peroxide to ship ballast water in an amount and for a period of time sufficient to destroy the cysts of noxious plankton therein and prevent their contaminating navigable waters. See, for example, the English Abstract and Claim 1 of U.S. Patent 5,256,423 (Egusa), which corresponds to Shuzo. According to Egusa,

hydrogen peroxide must be added to the ballast water in an amount such that its concentration in the ballast water comes to about 10 to 500 ppm (Egusa, Claim 2) and that concentration must be maintained in the ballast water for a period of time ranging from 3 to 40 hours (Egusa, Claims 4, 7, and 9). The Examiner acknowledges that Shuzo (Egusa) "is different than the claims in that Shuzo does not teach the use of ferrous ions, catalase, or iodine" (FOA, p. 3, para. 5).

With regard to Applicants' ferrous limitation, the Examiner found (FOA, p. 3, para. 6):

> Ikuta teaches that $FeSO_4$ was used at 0.25ppm (Ikuta p. 449 col. 2 lines 25-30) in combination with hydrogen peroxide (Ikuta p. 449 col. 1) to prevent biofouling in seawater (Ikuta Abstract). Ikuta teaches that the use of $FeSO_4$ with hydrogen peroxide has a synergistic effect when used to control mussels (Ikuta Conclusion). Therefore it would have been obvious to a person having ordinary skill in the art . . . to use $FeSO_4$ with the method of Shuzo to produce a synergistic effect when controlling organisms with hydrogen peroxide in the ballast water.

Applicant suggests that the combined teachings of Shuzo and Ikuta would not have led a person having ordinary skill in the art to the method Applicant claims.

First, there is no teaching or suggestion in Ikuta that any combination of hydrogen peroxide (0.25-1.4 ppm) and $FeSO_4$ (0.1-.0.25ppm) exterminated mussels or exterminated any other macro or microorganism in the seawater used for industrial cooling. Ituka appears to show that fewer mussels attached to experimental pipes made of acrylic resin and to the intakes, pipes, and heat exchangers of a power plant treated with a combination of hydrogen peroxide and ferrous ion than attached to the same when treated with hydrogen peroxide alone. However, Ikuta's controlling mussels or preventing biofouling by mussels would not have meant exterminating to a person having ordinary skill in the art, and the Examiner has not otherwise established that it would. To the contrary, attached hereto is a 1988 article (Nishimura et al., "Development of a New Antifouling Method For a Marine Cooling Water System," Marine Biology, Vol. 99, pp. 145-150 (1988)) by four of the five authors of Ikuta

which suggests, as does the plain language of Ikuta, that when Ikuta refers to "befouling control" by application of Shellnon V-10, Ikuta means controlling the growth, growth rate, and settlement behavior of mussels, barnacles, and other macroorganisms in the pipes of seawater cooling systems. Ikuta appears to compare the number of fouling organisms present in treated systems and their growth and weight in the treated systems to untreated controls (Ikuta, p. 449, col. 2, first and second full para.). Moreover, none of the cooling systems in which Ikuta's method was tested is a closed system which is ever depleted of oxygen for a significant period of time, like ship ballast water. In fact, the short duration of the system treatment time is reflected by the flow velocity (0.1 m/s for 24 hrs.) of the treatment composition added to the cooling seawater passed through the pipes of the system. Ikuta does not report that Shellnon V-10 was effective in exterminating microorganisms or macroorganisms viable in ship ballast water.

The prior art cited by the Examiner has not established that any organism viable in ship ballast water can be exterminated by combinations of hydrogen peroxide and ferrous ion in the concentrations Ikuta describes for any period of treatment. Nor does Ikuta mention the relative stability of hydrogen peroxide in seawater with and without the addition of $FeSO_4$. Ikuta is concerned that mussels do not settle in and block industrial cooling pipes.

A person having ordinary skill in the art would not add ferrous ion to the ballast water Shuzo treats with hydrogen peroxide to destroy organisms viable therein in view of Ikuta's teaching. The Examiner's explanation is inadequate, and the combination of references simply do not bar the patentability of the method Applicant claims over the applied prior art teachings. This is especially true when Applicant is first to fully comprehend all the extermination and dissolved oxygen concentration requirements necessary to effectively treat ship ballast water and protect the environment.

With regard to Applicants' catalase limitations, the Examiner argues (FOA, p. 4, para. 7):

> Kozo teaches the use of catalase, in concentrations of 0.01ppm or more, with hydrogen peroxide in controlling marine organism fouling (Kozo English translation abstract). The Merck Index teaches that catalase is an enzyme, which promotes the decomposition of hydrogen peroxide to water and oxygen (Merck Index Monograph 01990). Therefore, it would have been obvious to a person of ordinary skill in the art . . . to provide catalase in the method of Shuzo to control marine organism fouling and promote the decomposition of excess hydrogen peroxide.

Applicant disagrees with the Examiner's conclusion for many reasons.

First, Applicant urges the Examiner to consider more of Kozo's disclosure. A reference should always be considered for everything it would have fairly taught a person having ordinary skill in the art. *In re Lamberti*, 545 F.2d 747, 750 (CCPA 1976). Accordingly, for the Examiner's benefit we attach hereto a partial translation of Kozo (attached partial English translation of Kozo: at page 1, lower left column, lines 4 to 13; at page 1, lower left column, line 20, to lower right column, line 7; and at page 2, lower left column, lines 11 to 16). On further consideration, it should be evident that Kozo would not have taught a person having ordinary skill in the art to mix hydrogen peroxide and catalase together in ship ballast water with reasonable expectation of successfully exterminating organisms viable in ship ballast water. As recognized by Merck Index Monograph 01900, catalase enzymes "promote reactions involving the decomp[ositio]n of hydrogen peroxide to water and oxygen."

The Examiner will find on further reading Kozo (attached partial English translation) that Kozo is concerned that the cooling channels and heat exchangers of industrial power plants, steel production plants, and petrochemical plants which use cooling seawaters are subject to marine fouling by, for example, mussels, barnacles, and hydrozoans which cause blockage, reduce cooling efficiency, and create general havoc with industrial cooling equipment (Kozo attached translation of page 1, lower left column, line 20, to lower right

column, line 7). Kozo teaches a method of preventing fouling of open cooling systems by marine organisms, more particularly by mussels, barnacles, and hydrozoans. *Id.* Kozo is not concerned with maintaining oxygen levels in industrial cooling systems which are subject to oxygen depletion. In addition, Kozo does not appear to be concerned with exterminating the troublesome marine macroorganisms. Kozo is concerned with preventing fouling by marine macroorganisms. Antifouling and exterminating are not the same activity.

Accordingly, the Examiner has not shown that Kozo would have taught persons having ordinary skill in the art to treat the cooling seawater of industrial cooling systems with hydrogen peroxide and catalase to exterminate or destroy organisms as Applicant's claimed method and Shuzo's method require. Why then would a person having ordinary skill in the art combine hydrogen peroxide and catalase in ballast water? The simple answer is that the artisan would not have been led to do so.

Shuzo's method treats ship ballast water with hydrogen peroxide to destroy organisms. Shuzo teaches that, in order to destroy organisms in the ballast water, the concentration of hydrogen peroxide required to destroy organisms must be maintained in the ballast water for a period of time sufficient to destroy them, e.g., at least 3 hours (Shuzo, Claim 6). On the other hand, Kozo instructs (Kozo attachment, page 2, lower left column, lines 11 to 16; emphasis added):

> When the present invention is practiced, sequential injection using a combination of hydrogen peroxide and catalase is effective as a method of feeding chemicals. . . . [I]f the catalase and the hydrogen peroxide contact with each other prior to injection, the catalase will decompose the hydrogen peroxide. It is therefore important to add both the chemicals separately by two-liquid injection.

In other words, Kozo would have taught a person having ordinary skill in the art not to combine hydrogen peroxide with catalase in water, i.e., most especially in ship ballast water, because the hydrogen peroxide would decompose, the concentration of hydrogen peroxide will be reduced, and as a result, the antifouling or biocidal activity of any combination of

hydrogen peroxide and catalase will quickly become ineffective. Kozo suggests that marine organisms in the seawater of the ship ballast would not be exterminated by a concentration of hydrogen peroxide maintained at extermination levels for the period of time Shuzo requires if catalase also is added to the ship ballast water.

Because Kozo teaches that hydrogen peroxide and catalase should not be combined because catalase decomposes hydrogen peroxide, and if combined, that the concentration of hydrogen peroxide will be reduced and the biocidal activity diminished, the Examiner's alleged *prima facie* case of obviousness of Applicant's claims cannot stand. Accordingly, the Examiner should withdraw the rejection under 35 U.S.C. §103(a) over Shuzo in view of Kozo and the Merck Index 01900 as regards Applicants' catalase limitations.

As to Applicants' use of iodine, the Examiner has taken the position that Keisuke describes a disinfectant comprising (FOA, p. 4, para. 8):

> . . . iodide ions in concentrations between 0.00016 mol/l and 1 mol/L, or 20mg/l to $127x10^3$mg/L (Keisuke [0021] teaches the concentration, and Keisuke [0039] potassium iodide is used as an iodine source" with peroxide or peracetic acid (a peroxide supplier)(Keisuke [0020]). Keisuke also teaches that iodide is an effective disinfective (Keisuke [0024], "germicidal action of . . . hypoiodous acid"). Therefore, it would have been obvious to a person of ordinary skill in the art . . . to supply iodine in the method of Shuzo to control organisms in ship ballast water because iodine is a known disinfectant usable with peracidic acid.

Applicant respectfully submits that persons having ordinary skill in the art would not have concluded that the method Applicant claims would have been obvious in view of the combined teachings of Shuzo and Keisuke.

First, Keisuke describes a solution of hypoiodous acid for use in sterilizing various systems (Keisuke [0001-0002; 0007]). The hypoiodous acid sterilization solution is prepared by mixing (1) a solution of iodide ions, and (2) a solution of peracetic acid or hydrogen peroxide (Keisuke [0008]). The reaction proceeds as follows (X is an iodide ion):

$$CH_3COOOH + XH \Rightarrow CH_3COOH + HXO$$ (Keisuke [0023])

or

$$H_2O_2 + XH \Rightarrow H_2O + HXO \quad \text{(Keisuke [0028])}.$$

Keisuke teaches that the molar concentration of peracetic acid or hydrogen peroxide should be low compared to the molar concentration of iodide in order to generate hypoiodous acid efficiently (Keisuke [0023; 0028]). "[I]t is preferred to use . . . hydroiodic acid in excessive amount to hydrogen peroxide" (Keisuke [0029]). Keisuke prefers to drive the reactions to completion because the presence of unreacted peracetic acid and hydrogen peroxide can corrode metal drainage systems, can be dangerous, can decompose the desired hypoiodous acid, do not improve the germicidal activity of the mixture, and should be avoided (Keisuke [0024; 0029]).

Moreover, Keisuke teaches that the reaction of hydrogen peroxide and an iodide advances in a short time (Keisuke [0030]). The concentration of hypoiodous acid generated when hydrogen peroxide is added increases rapidly, i.e., maximum generation of hypoiodous acid occurring in about 5 minutes, and gradual decomposition of hypoiodous acid and decreased bacteriacidal effect results thereafter (Keisuke [0030]).[1]

Keisuke mixes minor amounts of peroxide to major amounts of iodide ion to produce an hypoiodous acid sterilizing solution. The sterilizing solution is applied in open air systems where depletion of dissolved oxygen is not a problem, and Keisuke specifically teaches that hydrogen peroxide concentrations are to be avoided for reasons including metal corrosion, decomposition of the active agent, and loss of biocidal activity. When hydrogen peroxide is added to iodide ion, hydrogen peroxide reacts quickly with the iodide ion, the hydrogen peroxide concentration in the mixture is diminished, and the biocidal activity of the mixture lasts for no more than 5 minutes.

[1] Keisuke prefers the ratio of hydrogen peroxide concentration to iodide ion concentration to be 1:1 to about 1:5 (Keisuke [0027]). To avoid corrosion, 25 mg/l or more peracetic acid should be avoided (Keisuke [0024]).

Given that the initial concentration of peracetic acid or hydrogen peroxide in Keisuke's sterilization mixture starts at no more than 25 mg/l and decreases to zero rapidly, persons having ordinary skill in the art reasonably would not have considered adding iodide ions to the hydrogen peroxide solutions Shuzo employs to treat ballast water in view of Keisuke's teachings. Keisuke's sterilization solutions lack the hydrogen peroxide concentrations Shuzo specifies and Applicant's claims require, avoid the presence of any hydrogen peroxide for a variety of reasons, and even when hydrogen peroxide can be present, remain biocidally active for no more than 5 minutes.

Shuzo and Applicant treat ballast water in a closed system, i.e., the ship ballast. Keisuke is unconcerned with maintaining oxygen levels in a closed system and maintaining sufficient hydrogen peroxide concentrations to do so, and is unconcerned with maintaining biocidal activity over periods more than about 5 minutes. Keisuke is also unconcerned with the environmental consequences of dumping large excesses of iodine into an ecosystem. For these reasons, and in short, on consideration of all of the teachings of Shuzo and Keisuke, the method Applicant claims would not have been obvious to a person having ordinary skill in the art. Persons having ordinary skill in the art would not add iodide to the hydrogen peroxide solutions Shuzo uses to treat ship ballast water. Therefore, the Examiner's rejections under 35 U.S.C. 103 over Shuzo in view of Keisuke fairly should be withdrawn.

Claims to combination treatments, like previously pending 7-9, are similarly allowable because the Examiner exponentially increased the use of hindsight to conclude that, in view of all the combined prior art teachings, it would have been obvious to a person having ordinary skill in the art to treat ship ballast water with a combination of hydrogen peroxide, iodide ions, catalase, and ferrous ions to exterminate organisms viable therein and to maintain the concentration of dissolved oxygen in the ballast water at a level viable to said organisms. Kozo and Ikuta do not teach extermination of organisms, do not teach

extermination of marine microorganisms, and do not teach extermination of organisms shown to be present in ship ballast water. Keisuke and Kozo do not maintain a concentration of hydrogen peroxide at levels sufficient to treat ballast water. Keisuke and Kozo teach persons having ordinary skill in the art how to control the growth, growth rate, and settlement of mussels and barnacles which tend to block the pipes of open cooling systems. Keisuke employs hydrogen peroxide and iodide ions to prepare hypoiodous acid disinfectant solutions and avoids the presence of, or eliminates hydrogen peroxide in, its disinfectants. The compositional combination of stability, contact time, and component concentrations necessary for Applicant's claimed method of treating ship ballast water with hydrogen peroxide in the presence of iodine ions, catalase, and/or ferrous ion to succeed in functioning as stated in Applicant's claims, i.e., to exterminate organisms viable in ship ballast water while maintaining the concentration of dissolved oxygen in ship ballast water at a level viable to said organisms, is not reasonably suggested by any combination of the references applied.

Finally, the rejection of Applicant's previous Claim 2 (now Claim 11) further in view of Tamura, U.S. Patent No. 5,256,701, issued October 26, 1993, is particularly troublesome. Tamura's alleged instruction to lower the concentration of iodide ions to a level at or below the concentration of hydrogen peroxide in a disinfectant solution is contrary to Keisuke's express instruction to maintain the concentration of iodide ions at or above the concentration of hydrogen peroxide in the system at all times. The teachings of Keisuke and Tamura, as summarized by the Examiner (FOA, p. 5-6, para. 10-11), appear inconsistent. The Examiner's multiple use of hindsight reconstruction is most inappropriate in this case because the purported goal of the patent laws is to promote the useful arts. The Examiner's rejections in this case do no such thing.

Conclusion

In a time when technology's concern for the environment is challenged on a daily basis, it is important to acknowledge the patentability of Applicant's critical advance toward controlling an environmental hazard. As discussed above at length, even the combination of references applied against the claims do not recognize, or address, the problem of effectively exterminating organisms in the ballast water of a ship while maintaining an oxygen level therein sufficient to sustain such organisms, thereby addressing the needs of both the shipping industry and the environment. Reconsideration and withdrawal of the rejections under 35 U.S.C. §103 over the cited art is now appropriate for the good and sufficient reasons presented herein, and Applicants thus request that the claims be passed to Issue.

Respectfully submitted,

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